



Traffic Choices Study

Findings from a Road Pricing Experiment

Washington State Transportation Commission

July 16, 2008

Lessons From A Road Charging Experiment



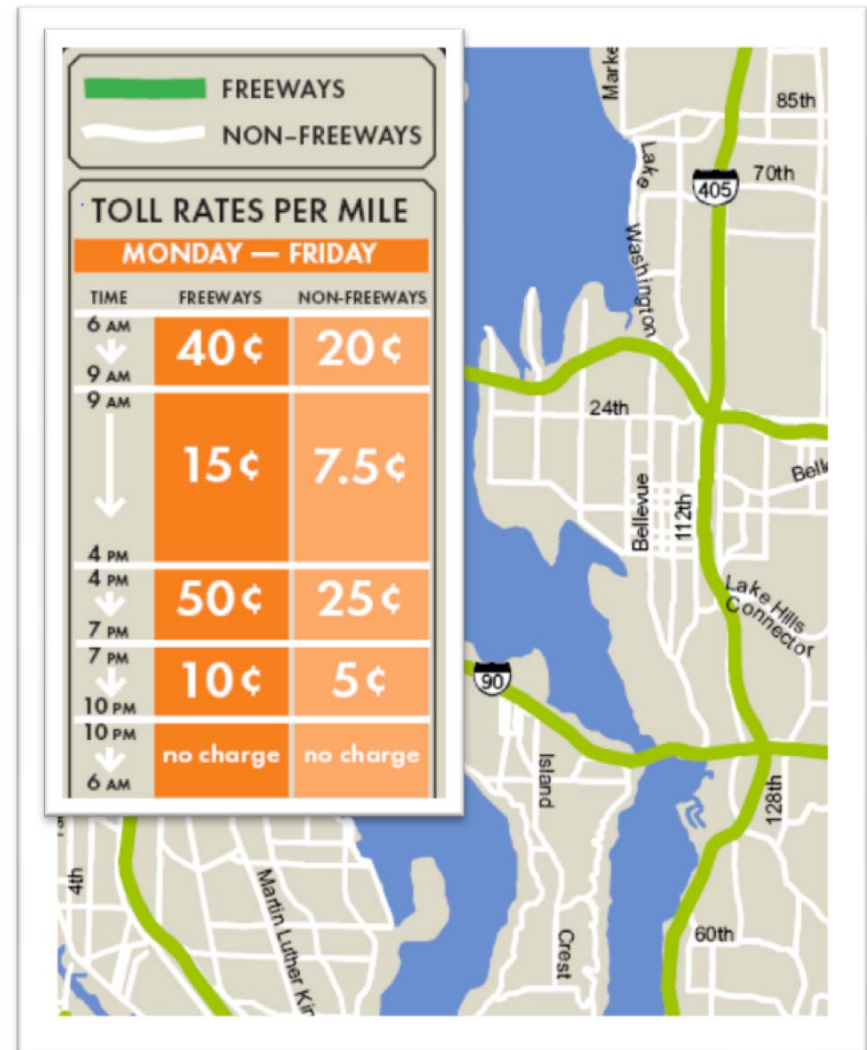
Project Background

Long-Term Finance Reform

Long-run viability of existing transportation finance approaches in question...

- TRB Special Report 285: The Fuel Tax and Alternatives for Transportation Funding
 - should undertake serious exploration of the potential of road use metering and mileage charging
- Surface Transportation Policy and Revenue Study Commission
 - The Commission recommends that the next surface transportation authorization act require a major national study to develop the specific mechanisms and strategies for transitioning to an alternative to the fuel tax to fund surface transportation programs

- **Detailed analysis of road user choice and behavior under a broad and sustained tolling experiment**
 - Tolling on all major roads
 - Tolls based on time of day and type of road
 - True price incentive with hold harmless design
- **Development and proofing of tolling technical applications and systems design**
 - In-vehicle GPS-based tolling
 - Cellular communicating to central system
 - Large-scale operational test showing the feasibility of network-wide tolling
- **A pilot for understanding key policy variables and requirements**

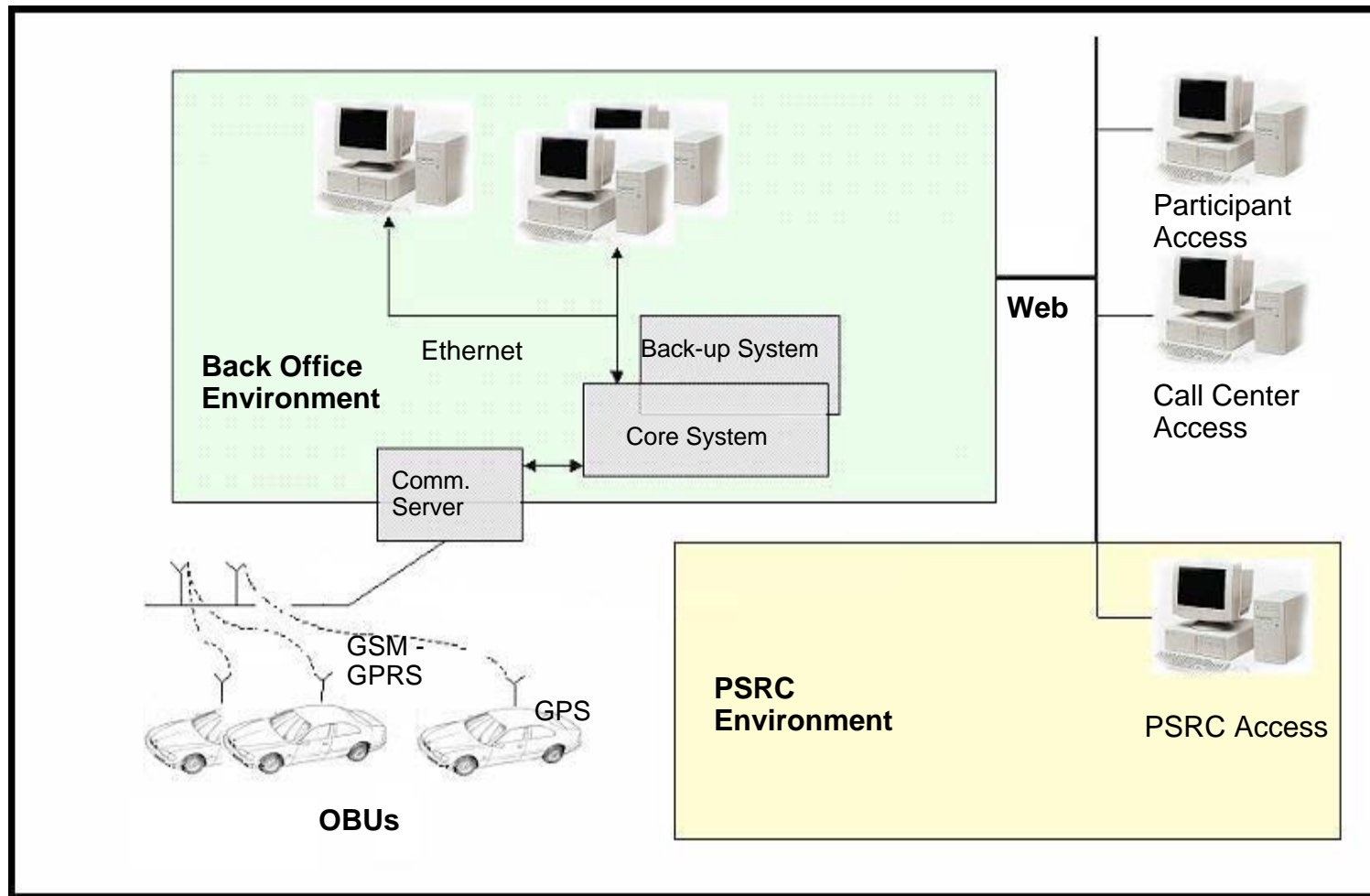


Participant-Centered Project

- 275+ households; 400+ vehicles
- Randomly selected from an enriched pool of potential participant households
- Each household was provided a unique travel endowment account, based on their baseline travel behavior
- Tolls were levied against this endowment account
- At the end of the tolling period participants were given any remaining account balance



Technology



Project Operations

- 450 OBU installations and removals
- System fully operational for over 18 months
- Over 270 participating households
 - Up to 18 months of trip data per household
- Hundreds of customer service calls
- Over 4,000 invoices distributed
- Over 100,000 device to central system transactions
- Over 750,000 individual trip records
- Household surveys and focus groups



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Behavioral Analysis

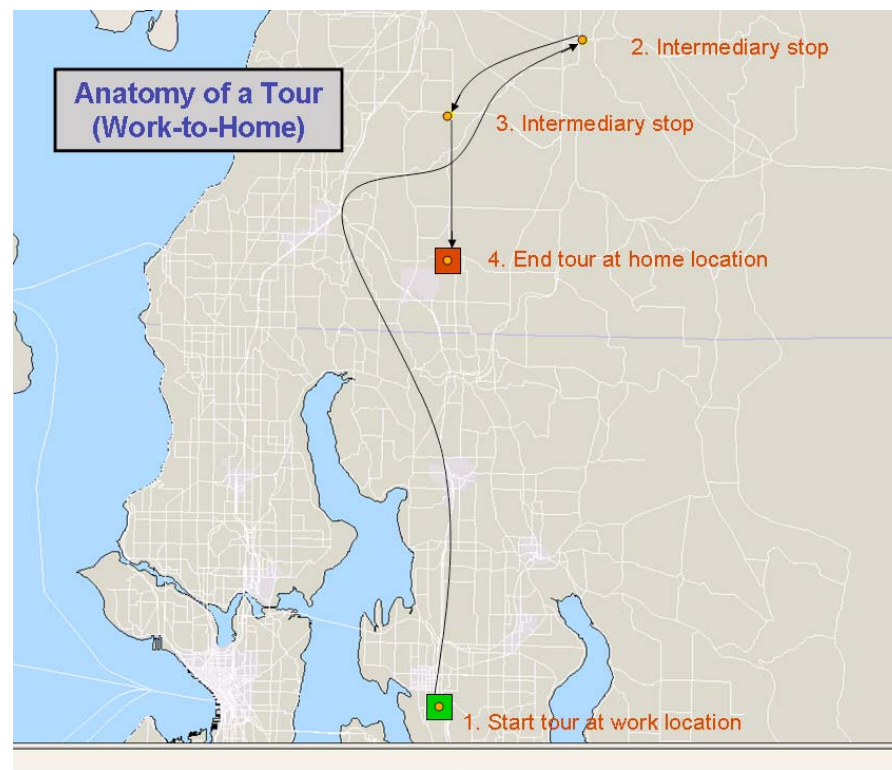
Data Preparation

Billing system provided detailed physical and financial information on trip activity

- Tolls paid, VMT by link type, travel time, speeds
- GPS provided information for reconstructing paths, trip ends, time of travel

Trip purpose and traveler demographics were appended to trip information

- Trip purpose had to be inferred using employment and land use records
- Tours were constructed from trip data
- Household income were both reported and inferred



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Descriptive Statistics

Figure 3. Average Home-to-Work Departure Time

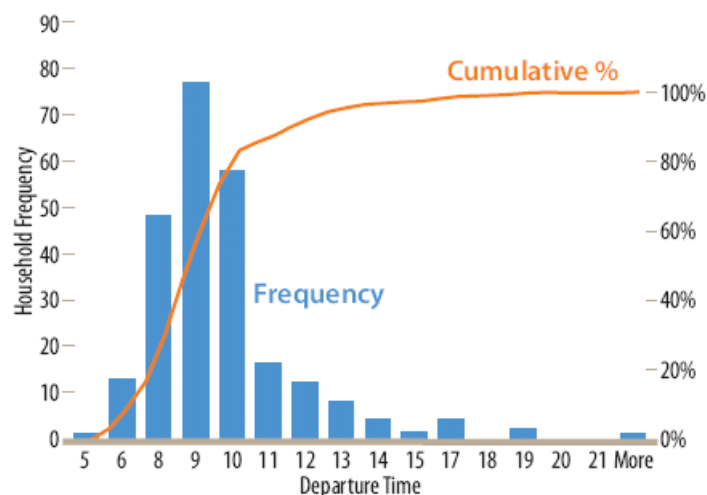


Figure 4. Average Work-to-Home Tour Departure Time

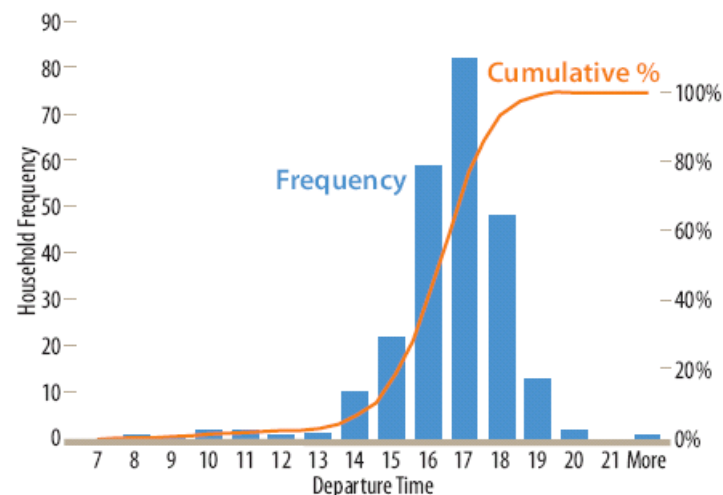


Figure 5. Average Home-to-Work Drivetime (Minutes)

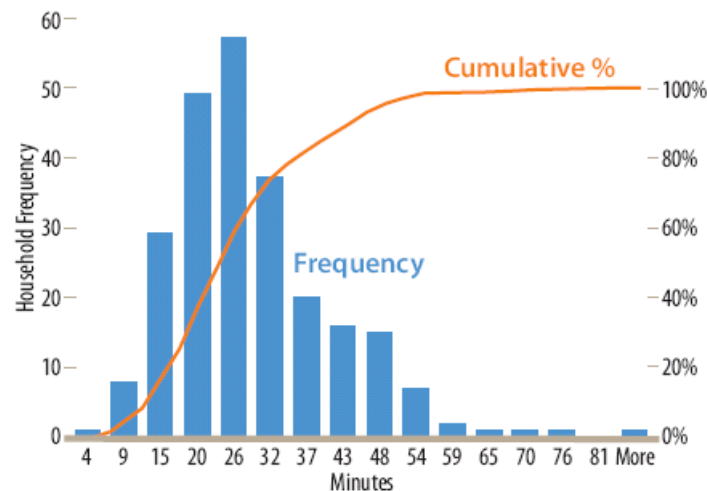
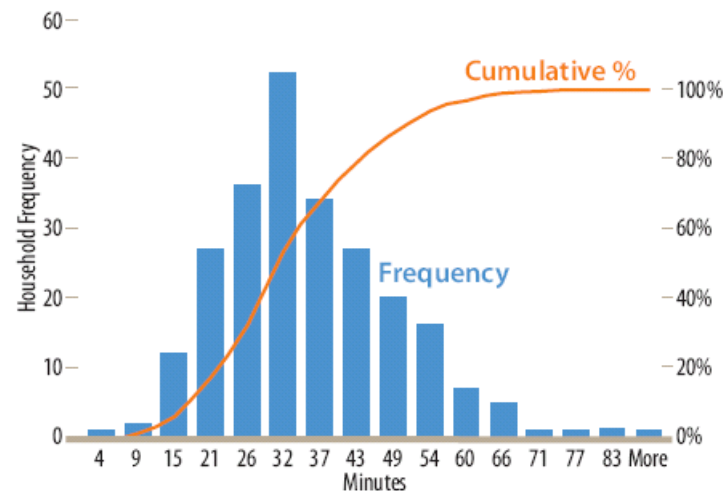


Figure 6. Average Work-to-Home Drivetime (Minutes)



Measured Dimensions of Demand Elasticity

- **Demand Dimensions**

- Tours Per Week
- Tour Distance (Miles Per Week)
- Drive Time (Minutes Per Week)
- Tour Segments (Segments Per Week)
- Tolloed Tour Distance (Tolloed Miles Per Week)
- Tour Start Time
- Tolls Paid

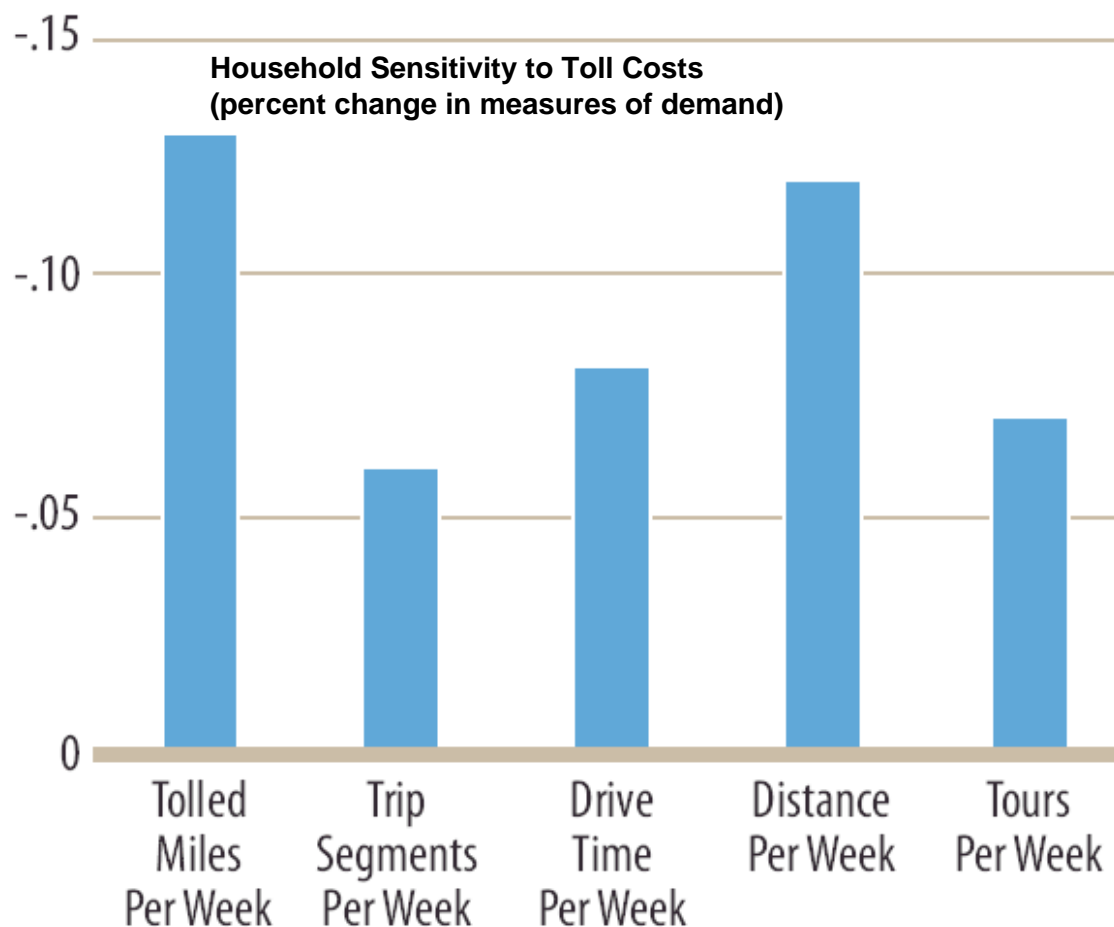
- **Across tour (trip) purposes**

- Home-to-Work
- Work-to-Home
- Home-to-Home
- Work-to-Work
- All Trips

- **Primary explanatory factors**

- Toll Costs
- HH Income
- Drivers per HH
- Transit Access

Drivers Responded to Tolling by Altering Their Driving Behavior

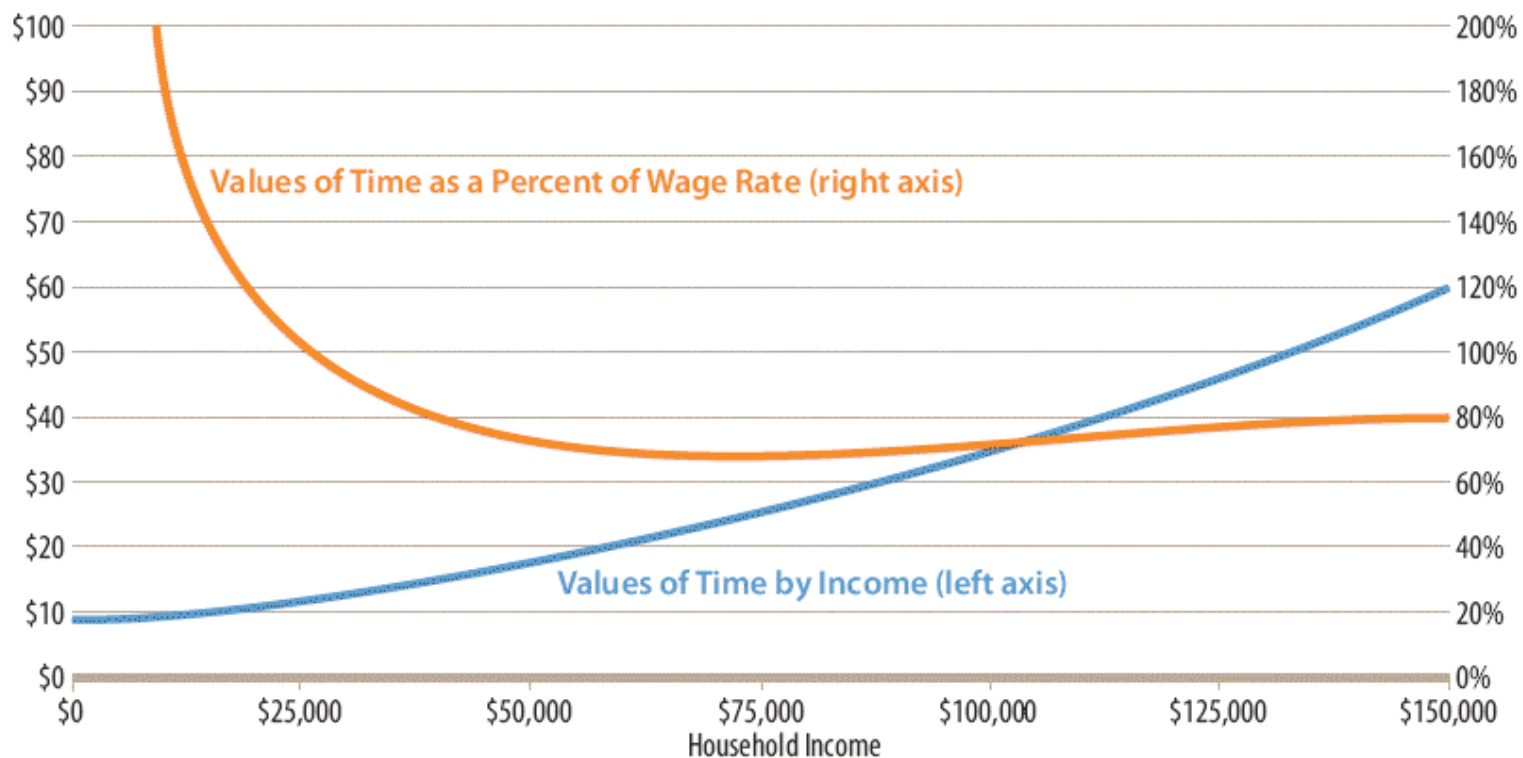


Motorists made small-scale adjustments in travel that, in aggregate, could have a major effect on transportation system performance.

Elasticities measure percent change in driving behavior in response to 100% increase in trip costs

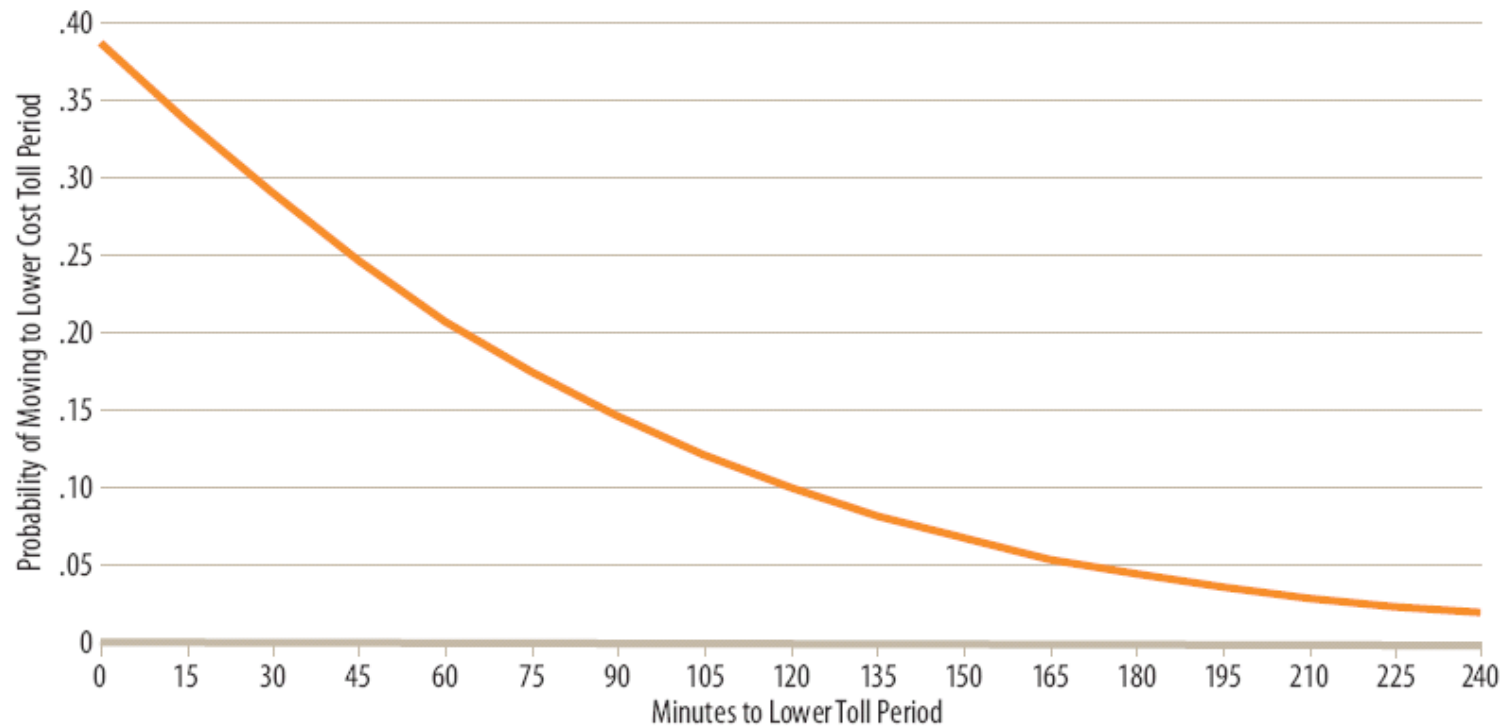
Value of Time Observations: Home-to-Work Tours

Observed Home-to-Work Tour Values of Time (As a Function of Route Choice)



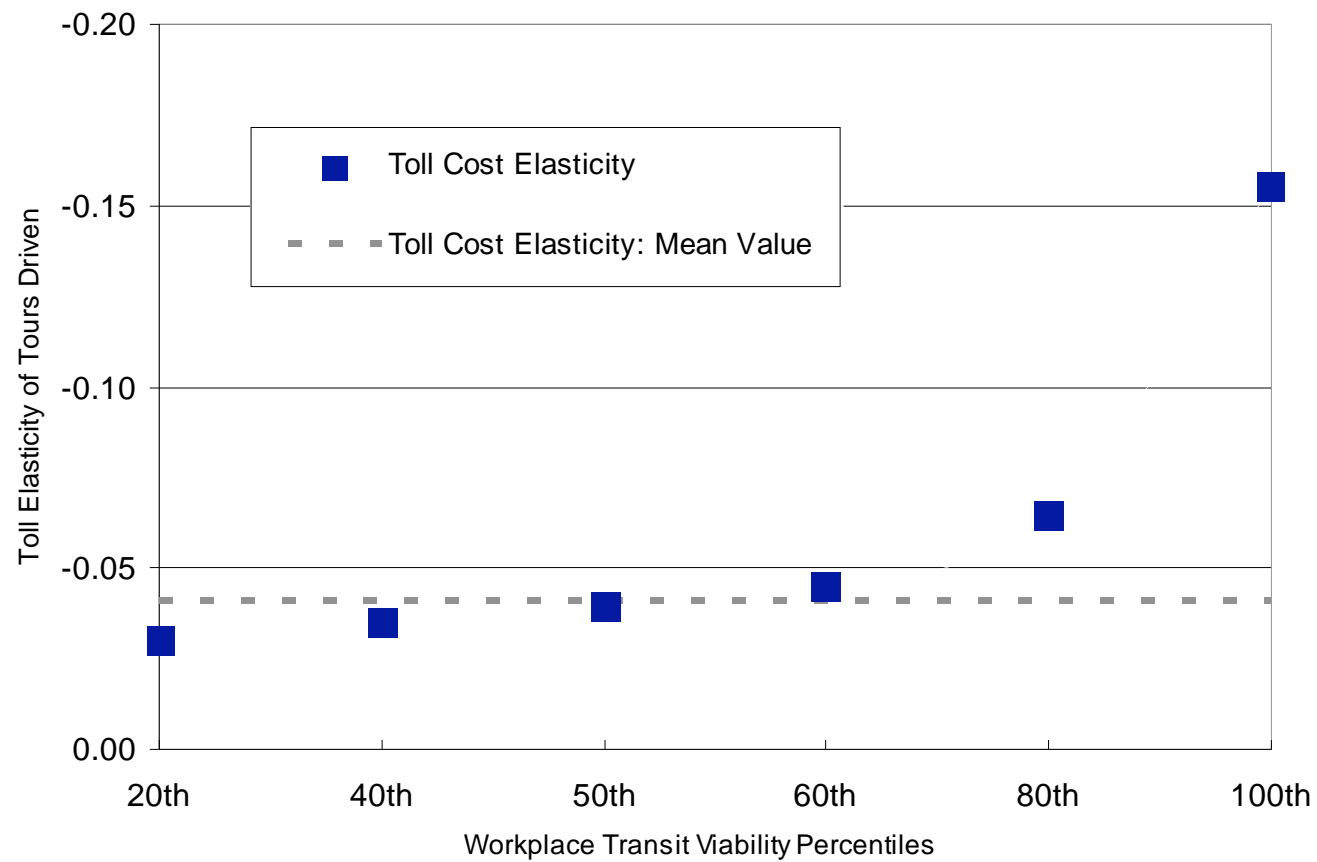
Departure Time Response

Home-to-Work Tour Probability of Moving to Lower Toll



Effect of Workplace Transit Quality on Response to Tolls

Wome-to-Work Tour: Transit Viability Influence on Elasticity of Tours



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Implications for Road Management

Lessons From A Road Charging Experiment

Baseline and Tolling Model Results

❑ Total VMT down 7%

❑ Total VHT down 5%

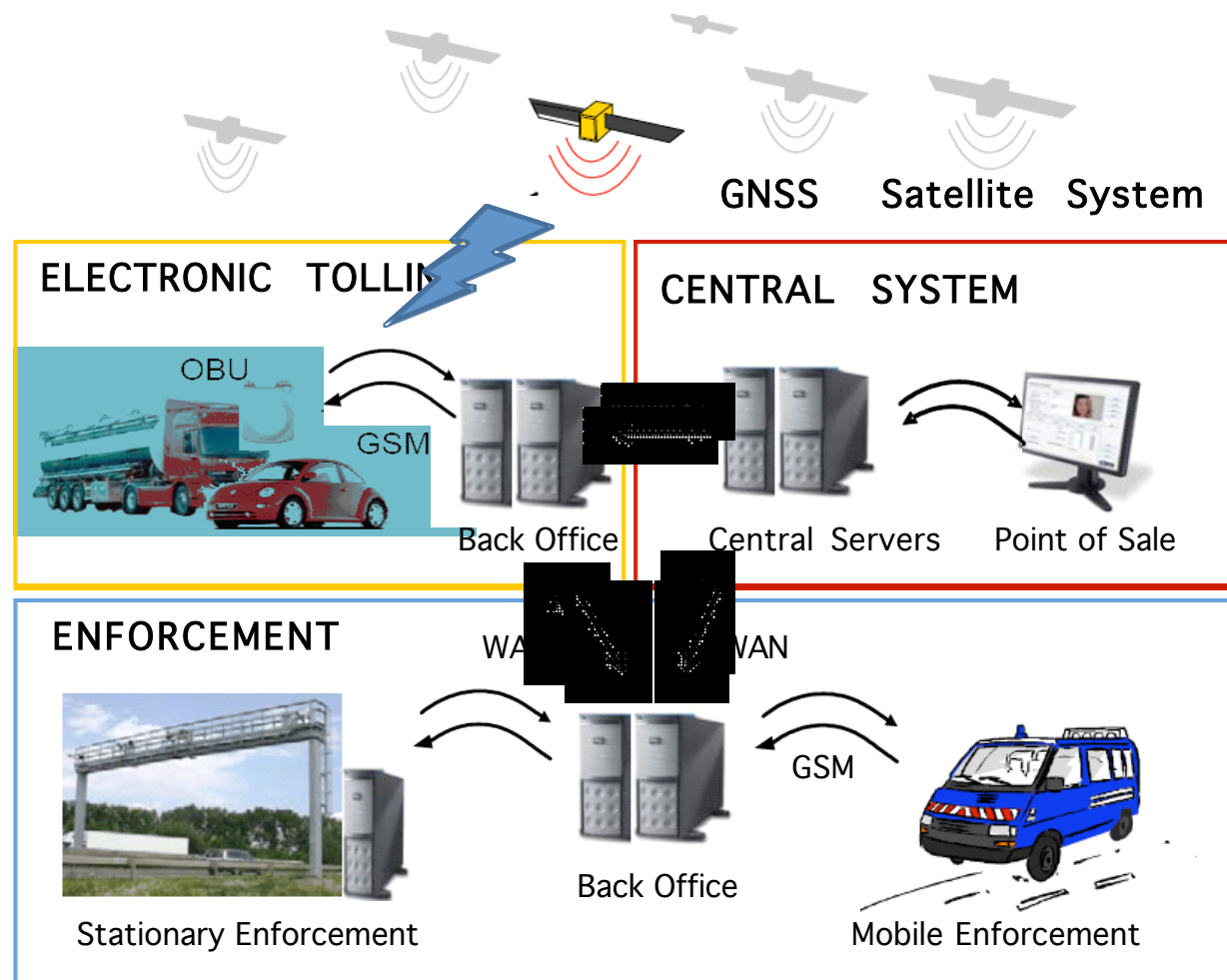
Baseline and Toll Scenario Travel Mode

Home Based Work	Base	Toll
SOV	79.3%	78.1%
Carpool	7.2%	7.9%
Transit	9.2%	9.5%
Transit-walk	7.2%	7.9%
Transit-auto	2.0%	1.6%
Bike	1.4%	1.7%
Walk	2.8%	2.9%
Non Work Trips	Base	Toll
SOV	46.0%	45.0%
Carpool	45.5%	46.4%
Transit	2.2%	2.3%
Bike	0.9%	0.9%
Walk	5.5%	5.5%

Baseline and Toll Scenario Travel Time of Day

Percent of Person Trips	Base	Toll
AM	15.7%	13.3%
Midday	37.8%	36.3%
PM	21.1%	18.4%
Evening	17.4%	18.5%
Night	8.0%	13.5%
Total	100.0%	100.0%
Percent of Vehicle Trips	Base	Toll
AM	13.1%	12.1%
Midday	42.1%	40.5%
PM	20.6%	18.9%
Evening	18.5%	19.0%
Night	5.7%	9.6%
Total	100.0%	100.0%

High Level Architecture for Network Road Pricing



Network Road Tolling Cost Estimate Central Puget Sound Region

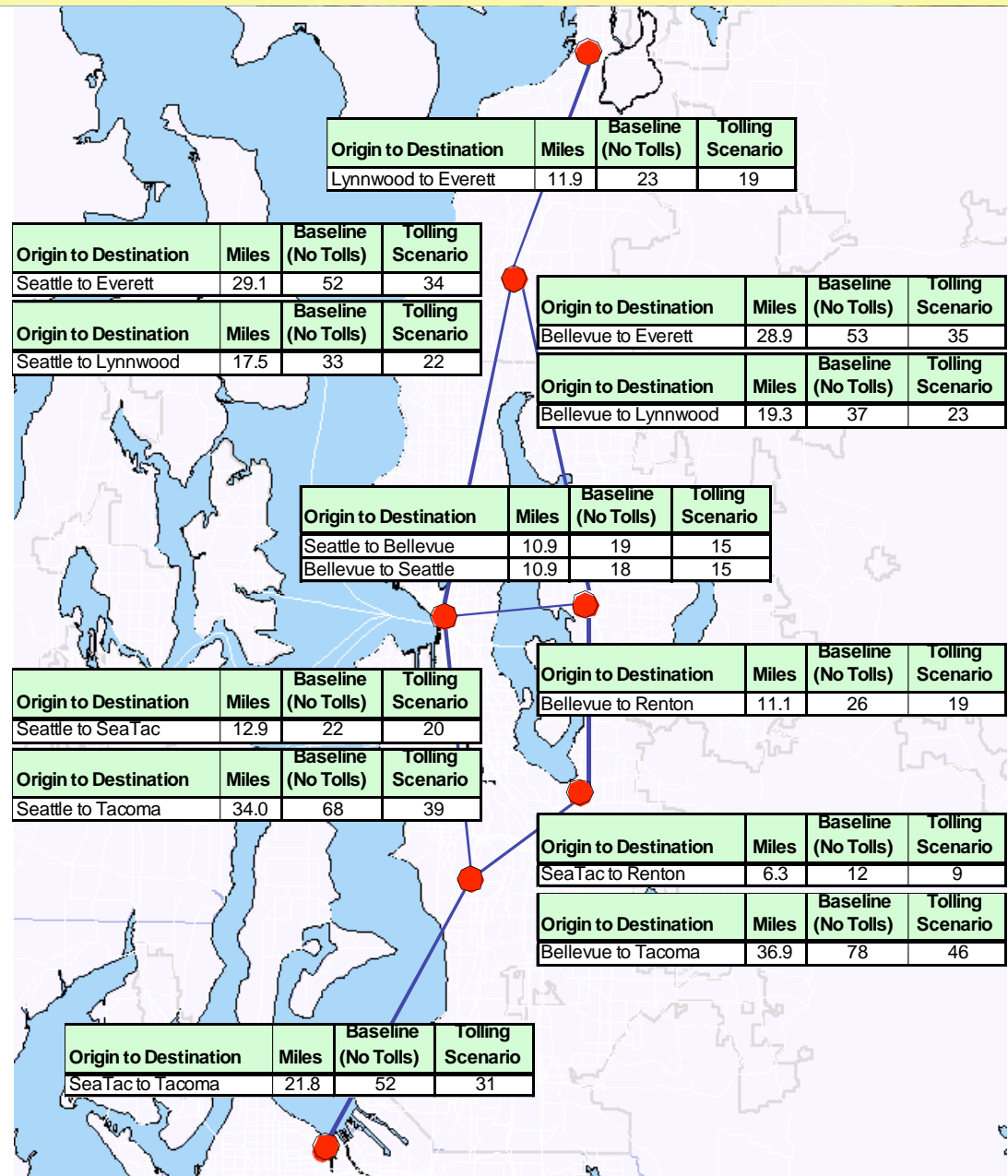
System Elements	Capital (2008 Dollars)	Annual (2008 Dollars)
OBU and installation	\$665,000,000	–
OBU / Installation – New Vehicles	–	\$31,500,000
OBU – Repair / Replacement	–	\$25,200,000
Training / Certification – Installers	\$500,000	\$50,000
Spare OBUs	\$1,750,000	\$20,000
OBU Subtotal	\$667,250,000	\$56,770,000
Stationary Stations	\$20,000,000	\$1,060,000
Transportable Stations	\$1,875,000	\$187,500
Mobile Stations / Vehicles	\$1,200,000	\$1,400,000
Enforcement Back Office	\$5,000,000	\$2,750,000
Enforcement Subtotal	\$28,075,000	\$5,397,500
Central System	\$25,000,000	\$20,000,000
Staff / Operations Training	\$500,000	\$100,000
Space for Central System / Back Office / Call Center	–	\$200,000
Central System Subtotal	\$25,500,000	\$20,300,000
Data Communications Subtotal	–	\$201,758,800
Other Subtotal	\$27,715,000	\$3,500,000
Grand Total	\$748,540,000	\$287,726,300

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Afternoon Peak Travel Times

Drive alone work trips
Across all paths

Base Case vs.
Tolling Scenario



Benefits and Costs of Network Road Tolling

Present Value Benefits/Costs	Millions of 2008 Dollars
Benefits	
Time Savings	\$36,600
Reliability Benefits	\$4,500
Operating Cost Savings	\$2,500
Toll Effects on Consumer Surplus	-\$97,100
System Operator Benefits (Tolls)	\$87,000
Present Value of Benefits	\$33,600
Costs	
OBU Costs	\$1,500
Enforcement	\$100
Central System	\$500
Data Communication	\$3,300
Other	\$100
Present Value of Costs	\$5,500
Present Value of Benefits less Costs	\$28,200
Benefit-to-Cost Ratio	6.1

Estimating Revenue Potential

Gross proceeds from variable network tolls (not necessarily optimal toll rates):

\$2.8 - \$3.2 billion per year

Region's share of State fuel tax proceeds:

\$500 million per year

Costs for a fuel tax collection system

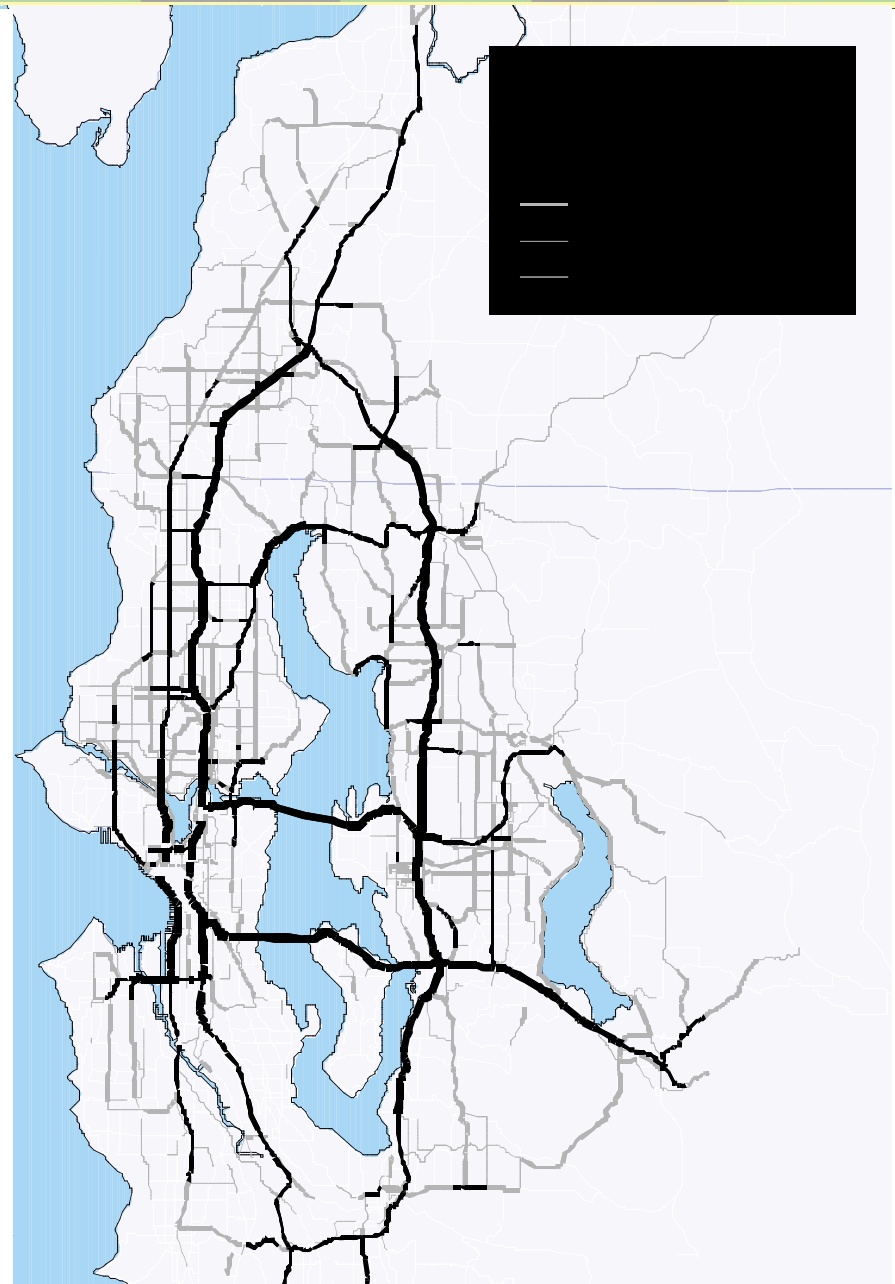
- Initialization Costs = NA
- Operations = 1% of proceeds

Costs for a network tolling system, (based on cost model)

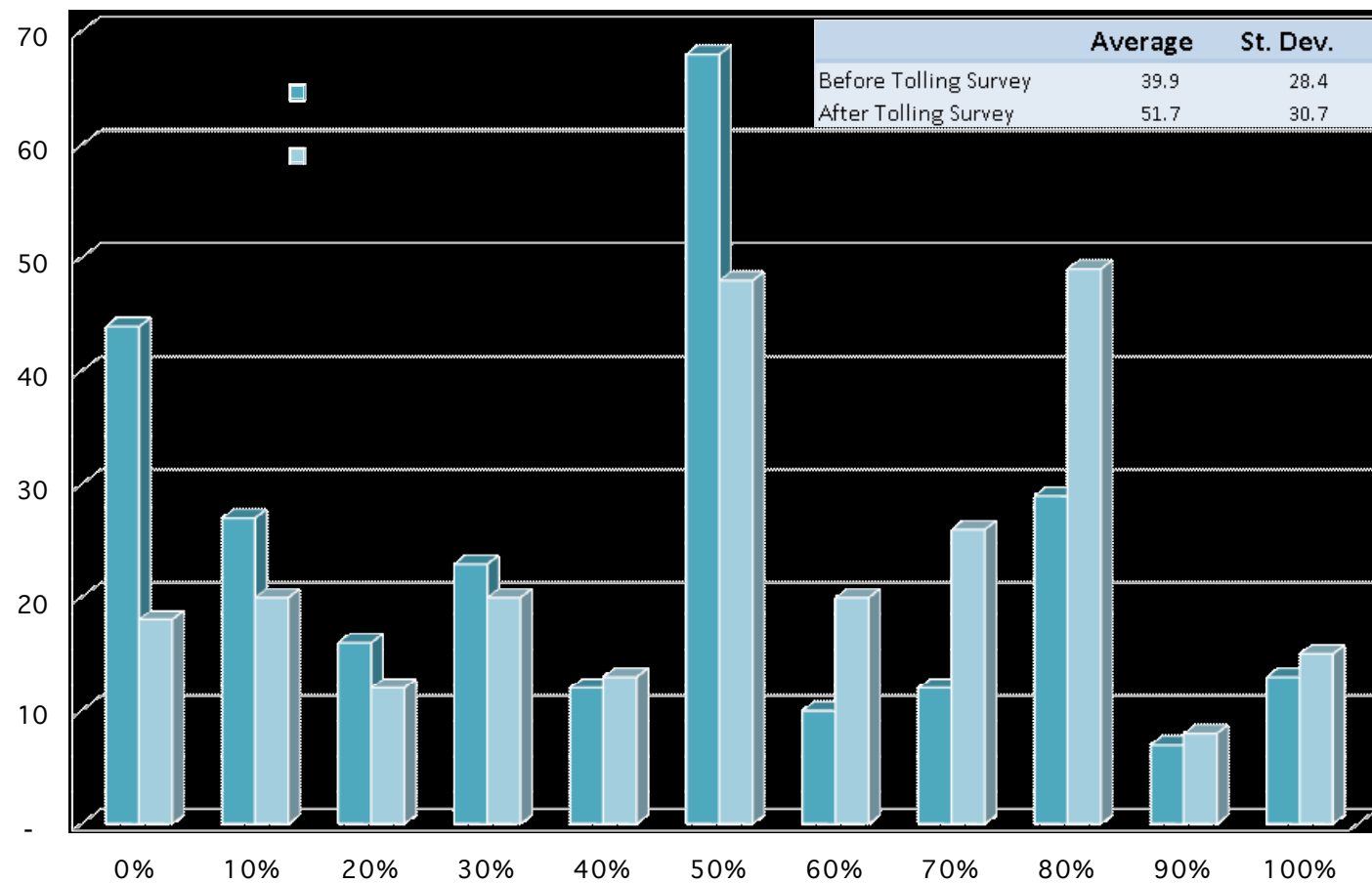
- Initialization Costs = \$750 million
- Operations = 5-8% of proceeds

Toll Revenues On the Road Network

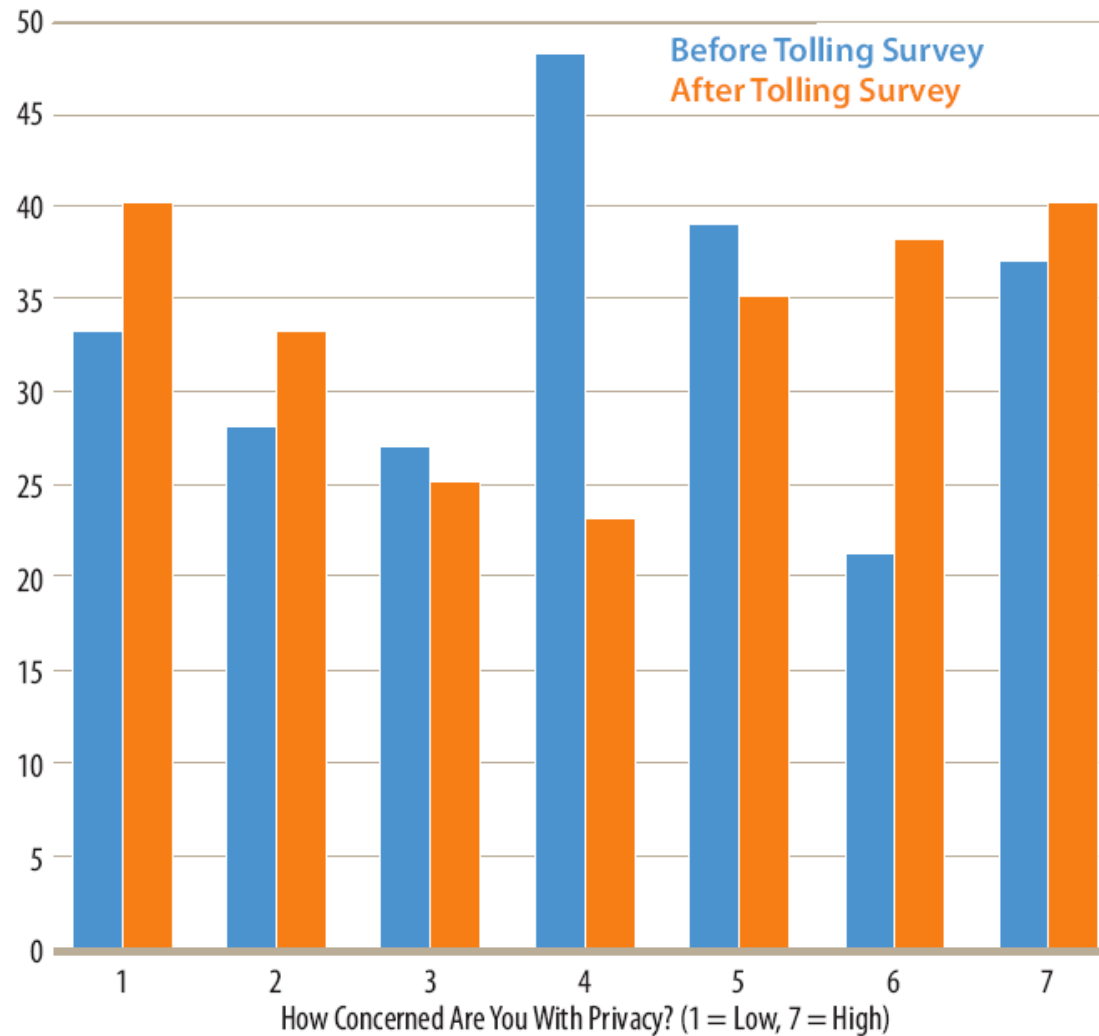
- 5% of centerline miles produced 50% of toll revenues
- Next 50% of revenues spread broadly across the core urban network
- 25% of the centerline miles produced less than 1% of total revenues



Participant Opinions on Funding



Participant Opinions About Privacy



Conclusions

1. Observed response of drivers to tolls suggests there is a dramatic opportunity to significantly reduce traffic congestion and raise revenues for investment.
2. Not all aspects of a road network tolling system have been fully demonstrated yet. But the core technology for satellite-based (and whole road network) toll systems is mature and reliable.
3. A large-scale U.S. deployment of a GPS-based road tolling program will depend on proven systems, a viable business model, and public acceptance of underlying concepts.

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<http://www.psrc.org/projects/trafficchoices/index.htm>